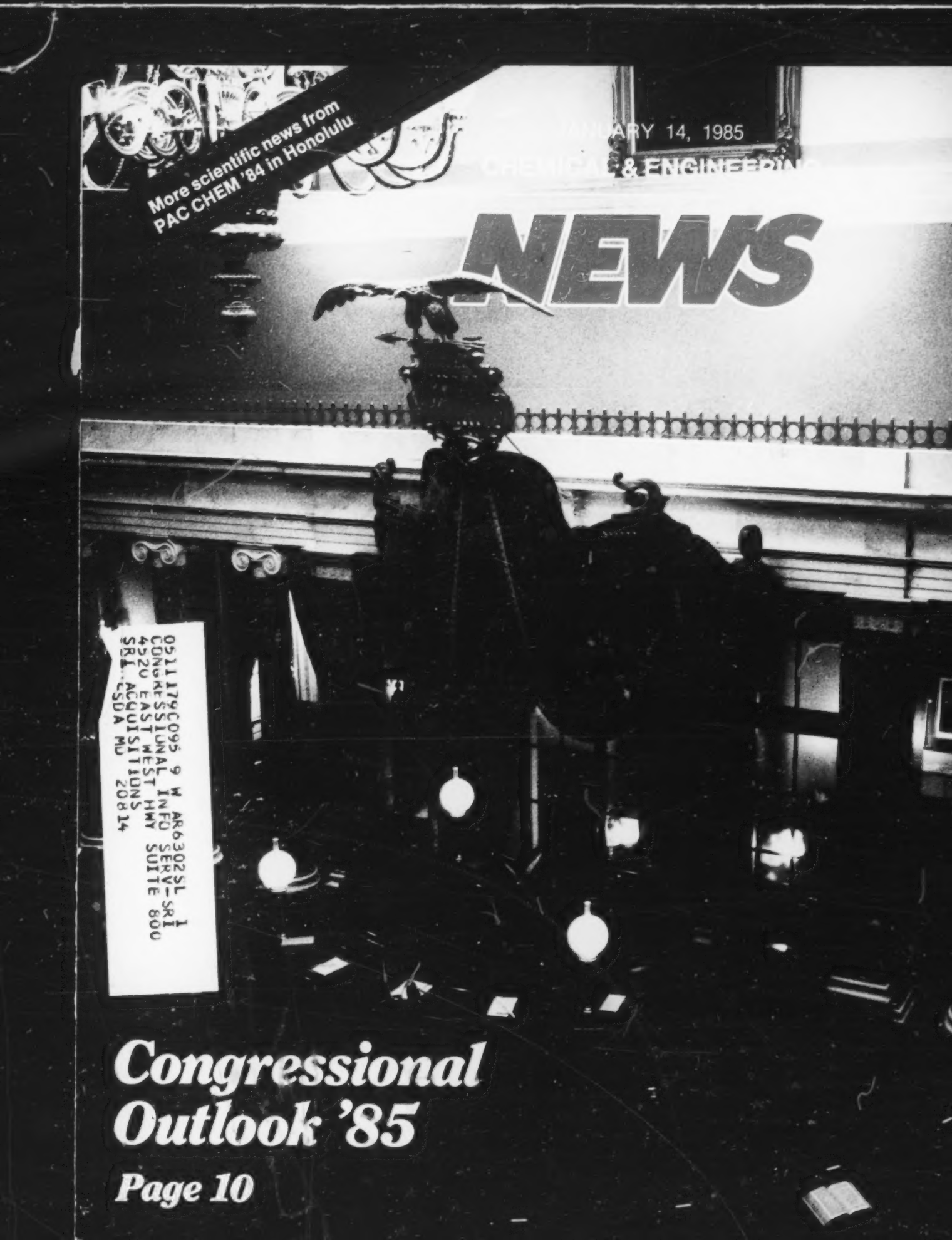

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Cover: Old Senate chamber in the U.S. Capitol. Photo by C&EN's David Hanson

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News Focus

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ations or litigation in the future. He did not say any negotiations are under way at present between Carbide and Indian parties, but he says he thought the Indians were listening to his requests for such talks.

"The issue has been: How do you get all those people represented in a negotiation rather than in a confrontation? That's what we've been working on," he says.

As a sign of possible rapprochement between the company and Indian authorities, Anderson revealed that Carbide's offer of $1 million for immediate relief assistance to India—a check that was rejected when first proffered shortly after the accident—has now been accepted by the prime minister's office in New Delhi "within the past week." A similar check for $840,000 from Union Carbide India offered to the state government of Madhya Pradesh apparently has not yet been accepted. Anderson stresses that the aid has nothing to do with potential compensation and says the original rejection of the relief funds was due to a misunderstanding of the company's motives.

Anderson also says that another good sign was news last week that the attorney general of India, K. Parasaran, would be visiting the U.S. soon to discuss jurisdiction issues. He says he hopes the visit, in which the Indian attorney general is expected to meet with American legal experts, will persuade the Indians to work toward settlement rather than to trust to litigation. He did not say whether he or Carbide representatives will attempt to meet the attorney general in the U.S.

In its efforts to foster negotiations, the chairman says, Carbide investigated the use of intermediaries but decided to let its own employees do the talking. On the other hand, the $1 million relief check was presented to the Indian government on behalf of Carbide by the U.S. ambassador to India, Harry Barnes, according to Carbide. Questions as to whether the State Department was involved in other ways, particularly in helping set up negotiations between the involved parties, received noncommittal answers from both Carbide and the State Department in Washington, which says it did not even know that Ambassador Barnes had presented the check. It also is unclear whether the Indian attorney general's plan to visit the U.S. might have come in response to U.S. urging.

In talking about the difficulty of creating just the framework for a settlement, Anderson says that the rush of U.S. personal injury attorneys to Bhopal had "confused the issue over there" and implied that the settlement process probably would be further along if they had not intruded. Anderson repeatedly has said that he considers India the proper place to work out a settlement and for litigation. Observers outside the company just as repeatedly have noted that it undoubtedly would be less costly for Carbide if India were to retain jurisdiction.

On another key issue—that of what precisely happened at the plant—Anderson explains that because of incomplete access to personnel and the plant, Carbide's investigation of the accident's cause probably will take another four to five weeks. He says he feels "reasonably sure" that the company will have an answer within that period.

Pointing out that many multinational manufacturing companies probably will be reappraising their overseas strategies as a result of the accident, Anderson also says that some good probably will emerge from the tragedy. "We have a commitment and an obligation to lead the way, if we can, to how we will now worry about safety," he says. "The world's going to be a better place. It's a hard way to learn a lesson, but if you went through a disaster like this and didn't learn anything, that would be the worst," he adds. □

R&D funding predicted to rise 11% in 1985

Research and development expenditures in the U.S. will surpass $107 billion in 1985, Battelle Columbus Laboratories says in its annual R&D forecast. That will be $10 billion (11%) more than the $97 billion that the National Science Foundation estimates actually was spent for R&D in 1984. Battelle adds that the real increase will be on the order of 3.9%, assuming a 6.5% inflation rate.

Of the total, industry will furnish $55 billion (51%), the federal government $49 billion (45%), colleges and universities almost $2.3 billion (2.1%), and other nonprofit institutions slightly more than $1.3 billion (1.2%). Until 1979, Battelle notes, the government provided more funds for R&D than did industry. But during the past decade, real R&D support has grown an average 5.4% per year (compounded) for industry, compared to 3.0% for government.

According to Battelle economists Jules J. Duga and W. Halder Fisher, industry will spend 11% more on R&D than in 1984. Eight broad industrial sectors each will spend more than $1 billion. Biggest spender will be the aerospace industry, with projected expenditures of $20 billion. But almost 76% of that will come from government, only 24% from the industry itself. In contrast, R&D in the other seven sectors—electrical machinery/communications, ma-

Chemicals R&D most heavily self-funded sector in 1985

$ Billions	Total funds	Industry funds	Government funds	Industry share
Aerospace	$20.01	$ 4.87	$15.14	24.3%
Electrical machinery/communications	16.94	11.28	5.68	66.5
Machinery	9.79	8.86	0.93	90.5
Chemicals	8.94	8.43	0.51	94.3
Transportation equipment	7.21	6.38	0.83	88.5
Instruments	5.47	4.63	0.84	84.6
Petroleum products	2.58	2.34	0.23	91.1
Rubber products	1.49	1.07	0.42	71.7

Source: Battelle Columbus Laboratories

chinery, chemicals, transportation equipment, professional and scientific instruments, petroleum products, and rubber products—will be heavily self-funded, with, on average, 82% of the total coming from the industries and only 18% from government. (For more on chemical industry R&D spending, see page 19.)

Battelle attributes the increase in industrial R&D support to a number of factors, including a good economic climate, response to foreign competition, and a lowering of barriers to cooperative research programs. Also, there are early indications that new financing methods (such as the R&D limited partnership) may be having an effect on total R&D spending.

The projected $49 billion federal contribution represents a 10% increase from 1984. The Department of Defense will account for 66% of the total, compared to 62% in 1984. Support of energy R&D will decline, except for defense-related and selected conservation programs. With the National Aeronautics & Space Administration's space shuttle program almost out of the R&D stage, NASA funds will shift to other areas, such as the space station. And, Battelle says, "continuing de-emphasis will be found on research in the 'soft' sciences, including those areas that support the environmental, ecological, and socioeconomic impact investigations presently mandated by law."

Regardless of the source of R&D funds, industry will do most of the actual work—75% of the total. Of the rest, in-house government R&D will account for 11%, academic institutions about 12%, and other nonprofit organizations about 3%. □

Monsanto to field test gene-modified pesticide

Monsanto has notified the Environmental Protection Agency that it plans to field test this spring a soil microbe that has been genetically engineered to make a protein insecticide. The microbe is *Pseudomonas fluorescens*, a common colonizer of corn and soybean root surfaces.

Monsanto scientists used a plasmid to insert the endotoxin gene from *Bacillus thuringiensis* into the genome of the soil microbe. *B. thuringiensis*, available in the U.S. from Abbott Laboratories and Sandoz, has been registered in this country for insect control on plant surfaces above ground for more than 20 years.

Robert J. Kaufman, Monsanto's director of plant science research, emphasizes that the engineered *P. fluorescens* is only a prototype of broader spectrum microbes the firm plans as products. The endotoxin is most potent only against lepidopteran insects. The black cutworm, which attacks roots of corn and soybeans, is one of these. Either genes for more toxins will have to be inserted into *P. fluorescens*, or blends of microbes that make other toxins must be developed. Monsanto will not have actual product candidates until 1986, Kaufman says, and testing will delay introduction of these until 1988.

Testing will take place in a diked, 1-acre field at Monsanto's St. Charles, Mo., research farm. Microbe-coated seed corn will be sown on a 0.3-acre experimental plot. Investigators will compare emergence of seedlings and eventual root damage in the experimental plot with those in a control plot. The diking is part of an effort to prevent spread of the engineered microbe from the field. Workers will have a methyl bromide fumigant ready if evidence of spread appears.

Another question is persistence of the engineered microbe. Previous tests indicate that it does not survive longer than eight to 14 weeks, and that it does not persist over winter. Such tests also suggest that the engineered *P. fluorescens* is equally or less competitive with other microbes than the wild strain. Thus it may not overgrow and disrupt the natural balance of soil organisms.

Monsanto sent its notification and data to EPA following an October 1984 policy statement by that agency claiming jurisdiction over genetically engineered pesticides (C&EN, Oct. 15, 1984, page 4). □

Plan may help refiners meet lead-in-gas rules

The Environmental Protection Agency announced last week a "banking" proposal that it claims would help refiners and importers meet expected new standards that will reduce the amount of lead additives allowed in gasoline.

The proposal would give industry the flexibility of reducing lead use in gasoline this year below the current standard (1.1 g lead per gal of gasoline) and bank, or obtain credit, for the difference. This banked credit could be used later by a refiner to meet stricter standards, or the refiner could sell the credits to other refiners or importers.

The agency has said refiners can begin accumulating credits as of Jan. 1, but cannot use them until the second reporting quarter of 1985. The proposed scheme would become ineffective by the end of 1987, presumably when the strictest standard (0.1 g of lead per gal of gasoline) is in place.

EPA is taking action to control airborne lead because of the metal's adverse effects on health.

The agency is expected to promulgate a rule lowering lead use in gasoline by the end of this month, or early in February, says chief of EPA's fuels branch Barry D. Nussbaum. He is unwilling to say whether the new standard would be 0.1 g per gal, effective next year, or a gradual phasedown to that level by Jan. 1, 1988.

Without knowing exactly what rule EPA will establish, the agency is "establishing a bank without knowing the rates," Natural Resources Defense Council attorney Eric Goldstein says. "Banking as a concept is an innovative way of regulating. It makes sense in some cases," Goldstein says. "But without knowing the ground rules of EPA's overall [lead phasedown] program, it is hard to know whether the banking proposal is strictly confined, well documented, and purports with the law," he adds.

EPA will hold a public hearing on its banking proposal Jan. 15 in Washington, D.C. □

Chemical Industry Will Spend 9% More on R&D in 1985

Big increases by Du Pont and Monsanto, spurred by research pushes in life sciences, highlight a mixed bag of spending plans

David Webber, C&EN New York

There is a technology race on in the chemical industry, and companies are spending money to win it. Du Pont and Monsanto, both of which opened big, expensive life sciences research facilities last year, are planning to add generous amounts of money to their research budgets this year. Several other firms, while planning to increase their research and development expenditures by smaller sums, also will raise their budgets more than 10%. It is all part of a trend that, although evidenced unevenly within a group of 14 selected chemical producers, reflects a general move to greater emphasis on R&D in the chemical industry.

The composite 9% increase in the representative group's R&D budgets for 1985 undoubtedly will raise the percentage of sales that the industry spends on research above the 4.1% attained in 1984. That share, considered a rough yardstick of relative interest in R&D, has grown steadily since reaching a recent low of less than 2.7% in 1978. In 1983, R&D spending as a per cent of sales nudged 4.0%.

The composite budget increase also means that chemical industry spending on R&D continues to grow in real terms. According to Battelle Columbus Laboratories, industrial R&D inflation in 1985 will amount to some 6%, giving the group an adjusted increase of 3% for the year.

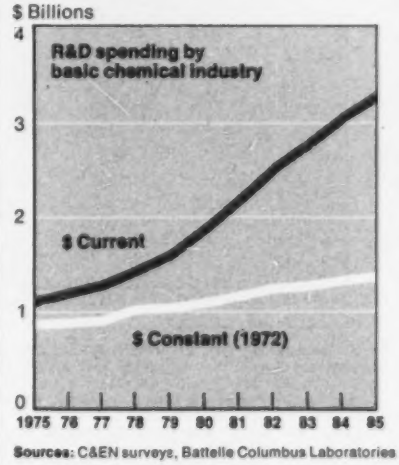
At the same time, however, employment of R&D scientists and engineers by the chemical industry seems to have peaked after several years of strong growth. The National Science Foundation reports that the number of such positions in the basic chemical industry dropped to 26,700 at the beginning of 1984 from 27,200 at the beginning of 1983. Recent indications from one major barometer of R&D hiring—the high-technology recruitment index maintained by the New York City consulting firm Deutsch, Shea & Evans—suggest that the pace of employment has reached a plateau.

This is not to say that firms will be hiring no new scientists at all. Monsanto, for one, says it plans to add some 600 employees to the research staff at its new life sciences research center outside St. Louis over the next few years. In general, however, the drop in NSF's tabulation of chemical R&D jobs suggests that firms will be spending more of their budget increases on research equipment and materials than on new scientists and support staff.

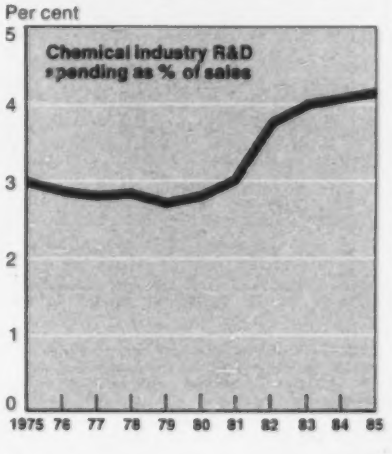
Monsanto and Du Pont continue to dominate the acceleration of chemical research spending. Du Pont, far and away the heaviest chemical R&D spender in the U.S., laid out $1 billion on R&D in 1984—excluding additional funds devoted to energy-related research conducted by Conoco. As a result, Du Pont (excluding Conoco) devoted an estimated 6.2% of last year's sales to R&D, a share that begins to approach levels customarily more typical of pharmaceutical than chemical firms. In 1985, Du Pont intends to boost research spending another $100 million, an increase that by itself will total more than the entire research budget of many a chemical producer.

Monsanto, which increased its R&D spending a third in 1984, has budgeted (according to preliminary estimate) as much as another 17%, or $65 million, for 1985 for a total of $450 million. In 1984, the com-

R&D budgets are rising faster than inflation . . .



. . . and surpass 4% as share of corporate sales



Sources: C&EN surveys, Battelle Columbus Laboratories

Larger share of sales was spent on R&D in 1984

$ Millions	Planned 1985	Actual 1984	Planned 1984	1983	1982	1981	1980	1979	Change from previous year 1985	Change from previous year 1984	R&D spending as % of sales 1984	R&D spending as % of sales 1983
Air Products[a]	$ 51	$ 44	$ 42	$ 40	$ 37	$ 32	$ 30	$ 24	16%	10%	2.5%	2.4%
American Cyanamid	250	240	235	215	190	172	148	130	4	12	6.2	6.1
Celanese	105	95	100	88	102	104	94	92	11	8	2.8	2.7
Dow Chemical	530	510	508	492	460	404	314	269	4	4	4.4	4.5
Du Pont[b]	1100	1000	945	875	775	647	591	509	10	14	6.2	5.7
Ethyl	42	42	39	39	39	37	34	29	0	8	2.4	2.2
W. R. Grace	90	80	82	71	62	55	45	42	13	13	1.2	1.1
Hercules[c]	79	70	66	74	74	65	57	50	13	−5	2.7	2.8
Monsanto[d]	450	385	385	290	264	233	208	161	17	33	5.3	4.6
Olin[d]	53	50	55	51	47	39	31	26	6	−2	2.4	2.6
PPG Industries	na	na	125	127	127	119	103	83	na	na	na	3.4
Rohm & Haas	120	109	100	100	92	77	67	54	10	9	5.1	5.3
Stauffer Chemical[e]	68	66	66	63	57	49	44	35	2	5	4.3	4.8
Union Carbide	275	255	250	245	240	207	166	161	8	4	2.7	2.7
TOTAL	$3218[e]	$2946[e]	$2998	$2643[e]	$2566	$2240	$1932	$1665			4.1%	4.0%
ANNUAL CHANGE	9%	11%	8%	8%	15%	16%	16%	13%				

a Figures are for fiscal year ending Sept. 30. b All figures exclude Conoco. c Figures up to and including most of 1983 include polypropylene-related R&D. Since November 1983 polypropylene R&D has been handled by Himont joint venture. d Figure for 1985 is preliminary estimate. e Excluding PPG Industries. na = not available.

pany spent some 5.3% of sales on research, a sure sign of R&D dynamism for a firm that never devoted more than 3% of sales to research throughout the 1970s.

R&D expenditures by Dow, still the second biggest chemical research spender, remain well above the industry composite at 4.4% of sales. So do those by American Cyanamid, which expends some 6.2% of sales on R&D—more than half on medical and agricultural research. Both firms, however, have scheduled just 4% increases in their research budgets for 1985.

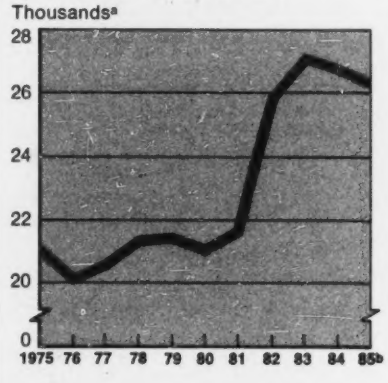
Several smaller firms have planned large percentage increases in their R&D budgets for 1985. Air Products, for instance, will boost its spending 16% to $51 million in fiscal 1985 (which ends Sept. 30). The company says that about two thirds of those expenditures will fund new technology initiatives such as core business-related research in advanced air separation technologies, polymer chemistry, amine chemistry, catalysis and inorganic chemistry, diversification-related research in electronics, advanced ceramics, industrial microbiology, and noncryogenic separations. The remaining third will be spent for existing technologies in core businesses.

Hercules has planned a 13% increase in 1985 to some $79 million. The company's level of R&D spending dipped in 1984 to $70 million from $74 million in 1983, but the decline was more a function of the assignment of Hercules' polypropylene activities to its Himont joint venture with Montedison in November 1983 than a reflection of decreased research emphasis.

W. R. Grace, having boosted its involvement in biotechnology last year, is adding another 13% to its annual R&D budget, and is now planning to spend $90 million on research in 1985. Still, it continues to devote the smallest share of its sales—just 1.2%—to R&D spending of any of the 14 chemical firms.

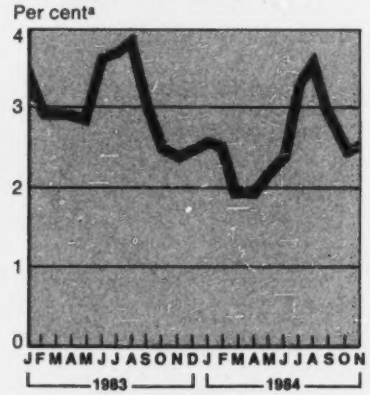
Rohm & Haas, traditionally a heavy research spender, will boost its 1985 R&D budget 10% to $120 million. The largest part of the company's research spending goes for polymer research, with work in agricultural and electronic chemicals also getting a lot of attention. □

Professional R&D staffs declining slightly...



a Full-time equivalent R&D scientists and engineers in basic chemical industry at beginning of year. b Estimate. **Sources:** National Science Foundation, C&EN surveys

...and technical professional unemployment rising a bit



a Unemployment rate for professional specialty employees, including engineers, mathematical and computer scientists, natural scientists, health diagnosing occupations, health assessment and treating occupations, teachers, lawyers, and judges. Not seasonally adjusted. **Source:** Bureau of Labor Statistics